

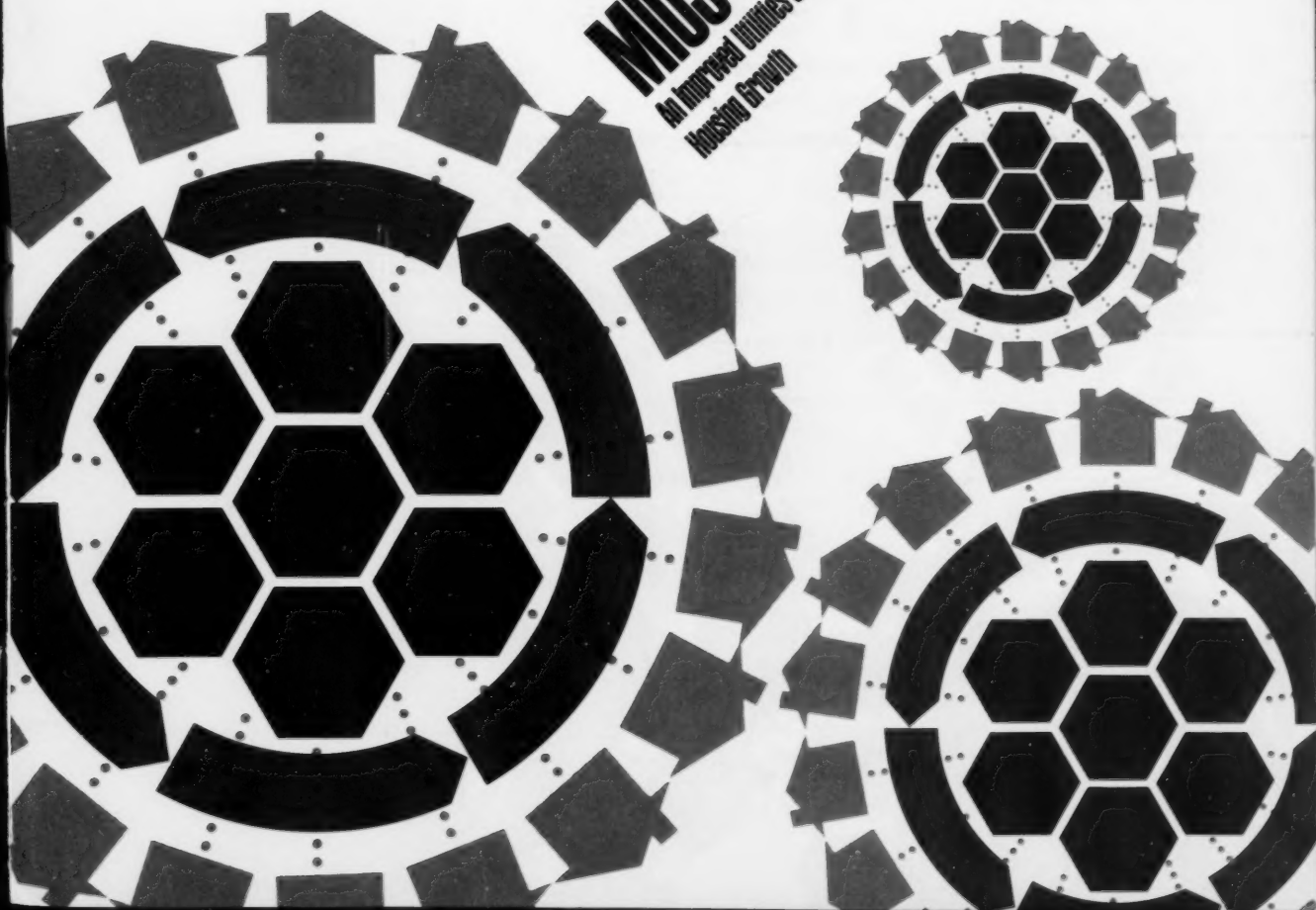
THE MONTHLY NEWS MAGAZINE OF THE NATIONAL BUREAU OF STANDARDS November 1976

# DIMENSIONS

NBS

A PUBLICATION OF THE UNITED STATES DEPARTMENT OF COMMERCE

**MUS**  
An Improved Business Option for  
Housing Growth



# DIMENSIONS

NBS

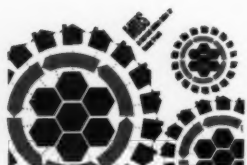
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## CONTENTS

- 3 MIUS May Provide Key to Increased Housing Production
- 8 Government Agencies Look to Private Companies for Computer Power
- 10 A Measured Environment: The Problem of Policy Versus Practicality
- 12 NIKE Missile Site Revisited
- 14 Highlights
- 15 Conference Planned on Corrosion of Metals in Buildings
- 15 Current Developments in Stereology Published
- 16 Catalog of 1975 Papers Available
- 16 NBS Scientists Win Four Awards in I-R 100 Competition
- 19 Calibration Service for Diagnostic X-Ray Units Provided
- 19 Report to Aid in Developing Computer Standard
- 20 NBS Publishes Voluntary Toy Safety Standard
- 20 Use of Color in Health Care Institutions to be Topic of Special Workshop
- 23 Publications

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**COVER:** Systems for providing public utilities may change drastically as a result of a new concept. See the story beginning on the opposite page.

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The Institute for Computer Sciences and Technology

Center for Radiation Research  
Center for Building Technology  
Center for Consumer Product Technology  
Center for Fire Research

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# Mius May Provide Key to Increased Housing Production

NBS assists HUD with innovative program to provide more efficient utility services to communities through Modular Integrated Utility Systems.

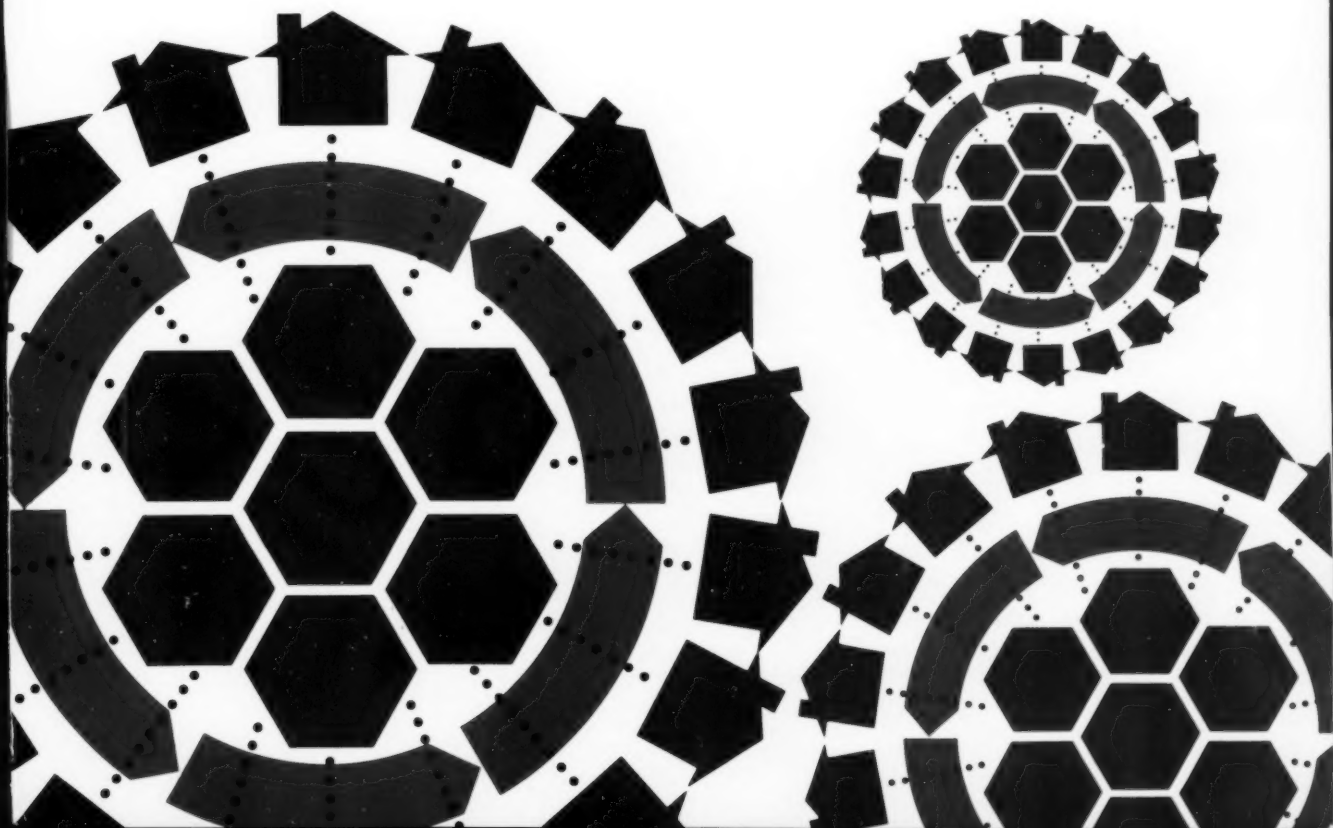
by Madeleine Jacobs  
NBS public information specialist

**I**N 1970 the Maryland State Department of Health and Mental Hygiene imposed a moratorium on new sewer hookups that literally ended all building construction—commercial or residential—because sewer capacity could no longer keep pace with demand. Although the moratorium has recently been lifted in many areas, one Maryland county executive recently proposed a strict and unprecedented quota for new sewer hookups that would greatly restrict construction of new apartments because they

place a greater burden on sewer capacity and public utilities than single family houses.

Meanwhile, it is common to see bumper stickers in many western states that read, "Visitors are welcome, homesteaders aren't."

These examples reflect responses to a common and increasingly serious problem. Tough environmental controls, the inadequate capacity of public facilities in the face of a growing population, and shortages of natural  
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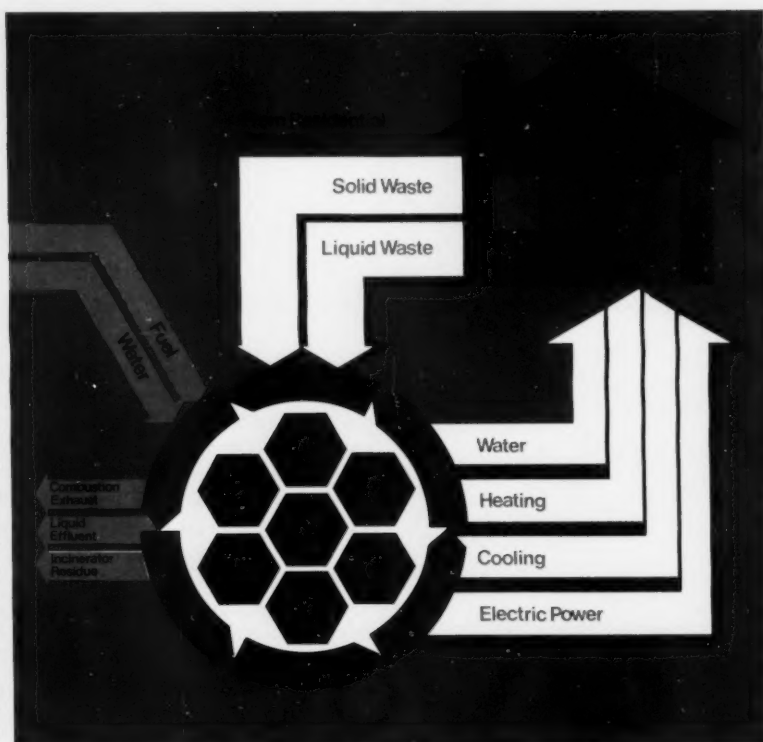
## MIUS continued

gas have drastically changed the housing picture in the United States. Over the past few years, many municipalities have been affected by an inability to meet the requirements for quality and quantity on wastewater effluent discharges. Demands on builders to help pay for sewer and other services have boosted the cost of houses to a level that has priced many young and low- and moderate-income families out of the market. The problem is expected to become more severe by the end of the 1970's, when the prime home-buying market in the United States—the population aged 25 to 45—will increase by almost 20 percent.

This problem has been a major concern to the Department of Housing and Urban Development as the federal agency responsible for improving the well-being of existing and new communities. One of its more important research efforts is the development of a Modular Integrated Utility System—or MIUS—which could serve the utility needs of new communities more efficiently than conventional systems.

The National Bureau of Standards is one of several government agencies assisting HUD in this effort. Under the direction of Clinton Phillips in the Office of Housing and Building Technology, NBS serves as a technical program advisor and as the lead agency involved in review and evaluation of the first full MIUS demonstration project to be funded by HUD. Assisting Phillips is MIUS Demonstration Project Leader John Schaeffen.\*

\* The HUD-MIUS project is headed by Jerome Rothenberg of the HUD Office of Policy Development and Research.



## "What's a MIUS?"

"A common question many people ask me is, 'What is a MIUS?'" says Schaeffen, who admits there are several ways to explain it. "A MIUS can be described as a system that brings together several subsystems that serve the different utility needs of a community and builds them into a master system that performs the combined functions as well or better than a conventional system. Physically, a MIUS could be a relatively small plant—located within a new residential and commercial development—that would provide all utility services: electricity, space heating and cooling, solid waste and wastewater treatment, and potable water."

The term "modular" in MIUS denotes its potential for construction in a schedule consistent with the community's growth—usually two years from design to operation of the plant. "Integrated" refers to its function as a multi-purpose plant to furnish all

utilities, with a total-systems approach in which the resource requirements of one utility would be met by utilizing—or recycling—the waste of another. For example, a MIUS might use waste heat from electrical generation and incineration for residential space heating or cooling, or it might use treated wastewater for process cooling water.

## Energy Savings

A significant advantage of a MIUS, Schaeffen explains, is the conservation of fuel through recovery of energy that normally is wasted when essential utility services are supplied from separate sources. "Conventional methods of generating electricity waste about 65 percent of the energy input directly to the environment," he says. "MIUS can recover better than half this waste energy and use it for space heating, air conditioning, water heating, water treatment, and wastewater treatment. And an additional five to 10 percent fuel savings is pos-

sible by recycling solid waste for its energy content."

In addition to saving energy, Schaefer points out that a MIUS minimizes the adverse environmental impact of many separate utility systems by reducing thermal pollution from the generation of electricity, air pollution from fuel combustion, water pollution from sewage, and land pollution from solid waste disposal. It is estimated that on the average a MIUS can reduce thermal pollution by 50 percent, combustion products by 35 percent, and solid waste by 65 to 85 percent. One other advantage of MIUS is that it can be built with existing technology and so-called "off-the-shelf" or commercially available components.

### MIUS GOALS

Using this total-systems approach, MIUS is designed to meet six main objectives: conserve fuel and other natural resources, reduce environmental degradation, reduce total public costs, match the reliability of service of separate utility systems, be capable of installation in phase with community development, and permit greater flexibility in intensive land development.

Obviously, a MIUS has a big order to fill. HUD has been moving toward its development in three phases. The first phase involves evaluation of the MIUS concept through analytical studies and through hardware tests and development. Hardware evaluation and development of MIUS include an extensive evaluation project being conducted by NBS since 1971 on a total energy plant located in Jersey City, N.J. (See box.) Also during this first phase, NBS scientists developed a detailed performance



(Photo by Hank Glittenberg)

Clinton Phillips (seated) directs the NBS program to review and evaluate the first full MIUS demonstration project, funded by HUD. John Schaefer, MIUS demonstration project leader, assists Phillips.

specification for HUD that spelled out the minimum performance levels for MIUS products and services. The factors taken into consideration were reliability, energy efficiency, environmental impact, natural hazards resistance, occupational safety, and community impact. As an example, the specification states the MIUS must maintain voltage within five percent of the nominal voltage. Another part of the specification limits the amount of nitrogen oxides and sulfur pollutants that may be emitted from the plant. There are more than 140 individual specifications similar to these.

### MIUS Demonstration

The detailed specification is now being used in the second phase of the HUD program—the demonstration of the technical and economic performance of MIUS. Recently, as part of this phase, HUD awarded a contract to Interstate Land Development, Inc., for the design of a MIUS demonstration plan that could provide all utility services for a residential and commercial community now under construction in the new town of St. Charles, Md., about 40 kilometers southeast of Washington, D.C.

turn page



## MIUS continued

The community in St. Charles is located on 53 hectares and will consist of a high rise apartment building with 108 units, six four-story apartment buildings with 205 units, and 200 townhouses. The MIUS would also serve a community shopping mall, office space, a high school and other nonresidential buildings. NBS has been monitoring the design effort for the project which is expected to result in a preliminary design and cost analysis in the next few weeks.

When the preliminary design is finished, NBS will help HUD evaluate it

against the NBS-developed performance specification. A final decision on construction of the MIUS plant at St. Charles will be made this spring. If all proceeds on schedule, the plant could be operational as early as 1978, according to the contractor.

### Interdisciplinary Efforts

In preparation for this second phase of the HUD-MIUS program—construction and evaluation of a MIUS—a team of scientists and engineers at NBS has been working to define the evaluation procedures, measurements,

and instrumentation required to determine accurately the performance of the plant. This performance will then be evaluated against several conventional utility system models. The long experience at NBS in developing new instrumentation and test methods for measuring energy use and for determining efficiency and performance of heating and cooling systems will be utilized during this phase of the project. In addition, the Jersey City total energy plant evaluation experience will be directly applicable to this effort.

Because a MIUS involves so many different areas, this is truly an interdisciplinary effort," Schaefer says. "At NBS we have mechanical, electrical, environmental and civil engineers, computer specialists, energy systems analysts, accountants, economists, and even legal specialists involved in this project."

### Implementation

The third phase of the MIUS program at HUD involves developing a data base from coordinated government activities. This data base will be used to encourage and assist implementation of the MIUS concept by private and municipal groups. Information developed in the program is made available to developers, architect/engineer firms, manufacturers, utility companies, community planners, financial institutions, and local governments. In addition, the program will investigate various aspects of the implementation process. HUD will also work with these groups to help implement the MIUS approach in planning community growth. For example, HUD will try to identify barriers to MIUS and develop methods of overcoming them. □



Top. This housing complex, in the area where the St. Charles development will be located, could be served by the MIUS, as could the school pictured below.



# Total Energy Today



If the HUD program goes completely as scheduled, it is possible that Modular Integrated Utility Systems would be used in a wide variety of applications in the 1980's, including planned unit developments, new towns, and urban redevelopments. Although MIUS is an important option for the future, total energy plants—the core of MIUS—are already here. In fact, total energy systems have been around in the United States for some time, but their application to date has generally been industrial and commercial. Most important, accurate data on the performance and reliability of the existing plants have not been collected and made available.



(Photo by Mark Helfer)

Top. This aerial view shows the Total Energy site in Jersey City, N.J.

Bottom. John Ryan (left) and Warren Hurley direct NBS research in support of HUD's Jersey City Total Energy Project.

The distinguishing characteristics of a total energy system are its generation of electricity locally with the recovery and reuse of waste heat for space heating, water heating, and space cooling. Currently, NBS is evaluating for HUD's Office of Policy Development and Research a total energy demonstration project in Jersey City, N.J. The multimillion-dollar project will demonstrate for the first time in the United States the economy, efficiency, and reliability of total energy systems compared to conventional utility plants. The information gathered in this evaluation also will provide valuable spin-off knowledge for the MIUS concept.

The Jersey City Total Energy Project is also under the direction of HUD's Jerome Rothenberg. At NBS, engineers John Ryan in the Office of Housing and Building Technology Communities Program and Warren Hurley of the Building Environment Division are directing the research.

*continued on page 21*

# Government Agencies Look to Private Companies for Computer Power

by Richard F. Dunlavey\*

**F**OR as little as a quarter, an 8-year-old girl can play a game of "Star-Trek" on a terminal connected to a \$3 million computer complex. For \$25 a congressional aide can track the status of the federal budget as it winds its way through a maze of legislative committees. And for \$2,450, an environmental specialist can run a simulation model that will help him predict the long-range effects of man-made chemicals on the nation's water supply.

These individuals, along with thousands of businesses, schools, and hospitals, have access to the latest in data processing technology through more than 100 private companies that now sell remote-access computer "time" for nearly any imaginable purpose. Recently the United States government has also begun to turn to the \$1.2 billion "time-sharing" industry as a way to satisfy its huge appetite for computer power.

Federal agencies have been directed to evaluate whether owning and operating in-house computer facilities are any longer justified in view of the quality and cost of services available from the private sector.

Unfortunately for the agencies attempting to follow this direction in

their long-range ADP planning, no reliable method has existed for projecting the cost of commercial computer services. An agency must first define a baseline of costs for computer-related functions, and there is no easy method to guide them. Secondly, to project expenses that will accrue when an existing workload is transferred to commercial services is even more difficult: The computer industry is highly competitive and companies prefer not to reveal how or what rates (generally imbedded in a complex "charging algorithm," or set of rules) they charge their customers. Thus, the prospective agency customer often has no basis on which to predict his monthly service bill.

Cost comparisons for an existing workload also depend upon identifying and quantifying workload characteristics that influence cost and then somehow translating this information into a form compatible with commercial charging algorithms. Finally, "workload" is determined almost as much by user behavior as by the programs and data that the computer actually processes. It is difficult to predict how individual users of one computer facility will adapt their behavior to the conventions of a second.

## Call For Help

The National Bureau of Standards began to help solve these problems

late in 1975 when the Data Management Center of the Department of Health Education and Welfare (DMC/DHEW) asked for assistance in comparing the cost of services at their large facility with that of equivalent services from a variety of commercial sources. A team of computer specialists\* from the NBS Institute for Computer Sciences and Technology was organized to compare costs for DMC and to develop a general approach that could be applied to other agencies faced with a similar dilemma.

## Estimating Commercial Costs

The biggest problem was to estimate the commercial charges for services equivalent to the federal computer services. The companies could not be asked directly to quote charges because in government procurements this approach elicits only the roughest approximation of actual costs. Vendors regularly discount their charges to government customers well below published schedules and the only price quotation to which a vendor is bound is the one that is bid in response to a formal government request for proposals. Ordinarily, an agency that makes a formal request has already decided to buy equipment or services.

\* Dunlavey is project leader for the performance measurement and evaluation project in the NBS Institute for Computer Sciences and Technology.

\* Headed by the author and Dr. Dennis Conti



Neither could the entire DMC workload be moved to several service bureaus for a trial period so that actual charges could be compared with past DMC costs. The expense of this solution—between \$300,000 and \$1,000,000 per service bureau—was obviously prohibitive.

### Two Approaches

In view of these difficulties, the NBS team adopted two parallel approaches. The first, or "algorithm" approach, was to obtain several commercial charging algorithms, characterize a representative month from the DMC workload (as recorded in a job accounting history file) in terms of the algorithms, and compute charges as if the DMC workload had actually run at each site.

The second, or "synthetic benchmark" approach, was to construct a set of computer programs (a "benchmark") representing the chargeable characteristics of the DMC batch workload, and to run this abbreviated model of the total workload at several commercial service bureaus. The charges at each service bureau were then extended by an appropriate "expansion factor" and the resulting totals were compared with DMC estimates of their costs for running the same workload in-house.

### Algorithms

Vendor cooperation in supplying and explaining charging algorithms for the algorithm approach was excellent. With the help of a COBOL program developed specifically for the purpose, this method accurately projected charges for every run of every program in the sample workload (approximately 26,000 runs). This job-by-job level of refinement permitted DMC to identify systems that would yield the greatest savings overall by being transferred and to match individual systems with the commercial services at which they would run most economically.

### Synthetic Benchmarking

Although the synthetic benchmarking achieved less resolution and somewhat less accuracy, it did prove to be an extremely simple and inexpensive method of approximating relative workload costs. It also verified the commercial algorithms used in the first part of the study. Synthetic programs were created (in FORTRAN) by a technique developed by the NBS team especially for this project to represent the resource demands of the total DMC workload on three critical system components: the central processing unit (CPU), main storage unit, and input/output channels. By the time the procedure was refined, it was possible to benchmark

vendor charges for less than \$200 per service bureau. (See NBS Technical Note 920 for a complete description of this technique).

### Needs Determine Choice

Overall, both approaches agreed in their service cost projections and the study team concluded that synthetic benchmarking was a more useful method for the agency that needs a quick and coarse estimate of comparative computer costs (especially since the General Services Administration has increased the freedom of agencies to contract for short-term commercial time-sharing services). Algorithm analysis is the best answer for agencies with specialized needs for a high degree of accuracy and resolution in their planning estimates. Neither method is a panacea for the problem of cost-estimating. Each needs to be refined and tailored to a specific task. And both must be supplemented by responsible estimates of technical service, tape/disk storage, and communications-related charges.

The development of these techniques represents a beginning, not an end, in the endeavor to make the federal government an informed customer in the area computer power. This effort is among the earliest attempts to respond to the increasingly clear requirement for agencies to plan and manage the services they will buy. □

# A Measured Environment: The Problem of Policy Versus Practicality

by George E. Brown, Jr.

U.S. Representative George E. Brown, Jr., from southern California, is chairman of the Subcommittee on the Environment and the Atmosphere, House Committee on Science and Technology. He is also a member of the Technology Assessment Board, the Agriculture Committee, and the Joint Committee on Atomic Energy. Congressman Brown holds a bachelor's degree in physics from the University of Southern California. The following article is taken from a speech delivered earlier this fall at the NBS 8th Materials Research Symposium on Methods and Standards for Environmental Measurement sponsored by the Institute for Materials Research.

**A**LL too often this past year, in celebration of the Nation's Bicentennial, we have failed to recall that our success and affluence have not been achieved without sacrifices, one of which has been the well-being and purity of our "space ship" Earth. Now is the time that we as a nation, and as a world community of nations, are considering, reaffirming, and expanding our goals for reclaiming and guarding a high quality environment.

This reaffirmation has been tempered by the realization that environmental goals must be balanced with, but not compromised by, their energy and economy-related objectives. The goals have been legitimized by persuasive new evidence of health

effects, such as the correlation of cancer to environmental factors in a majority (60-90 percent) of all cases. They have been influenced by the prediction of drastic global repercussions of seemingly minor actions, such as the release of halocarbons from common spray cans.

## Prevention Instead of Cure

The focus of the past has been on regulations to cure existing environmental degradation. Now is the appropriate time to think of the future: to strive for regulations and incentives to prevent the spread of this increasingly pervasive disease. In either case, the need for environmental measurement cannot be overemphasized. Whether controlling pollution, or preventing it, we must be able to identify all environmental contaminants and document the nature and extent of their damage to public health and welfare.

Scientists in the field of environmental measurement are constantly subjected to conflicting pressures. On the one hand, quality control measures stress the need for accuracy, reliability, and intercomparability of data and techniques. On the other, researchers are exhorted to produce inexpensive practical instruments on short order for immediate use in the field. I must admit that these diverging interests are incorporated into existing pollution control legislation, which often sets deadlines for com-

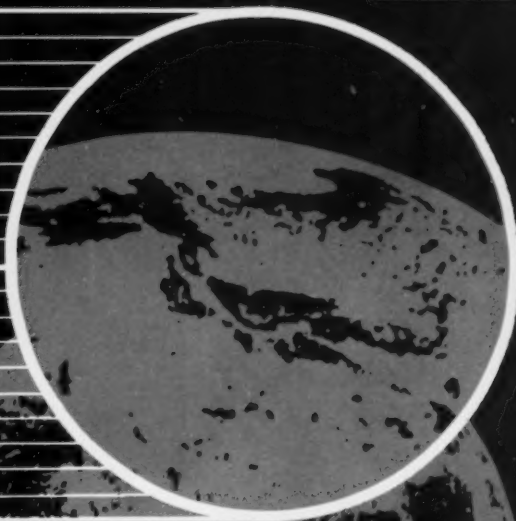
pliance with regulations, calls for use of "economically achievable" technology, and stipulates that the best, most reliable scientific data be used to justify policy decisions.

## Balance

Can these diverging interests be balanced? It is my belief that we are dealing with a hierarchy of needs. It might be useful to imagine a pyramid of instrument types: the narrow apex represents the most accurate, sophisticated apparatus which can be designed, the broad base the array of more rugged field equipment used to conduct daily monitoring and measuring tasks. The validity of the field data hinges upon the inherent accuracy of those "top" instruments, to which the simpler instruments have been standardized. Thus, it is of primary importance to attain the goal of accurate measurement and analysis before attempting to compare and qualify the data collected under varying conditions.

However, that data must be collected. We cannot afford to put off establishing a firm foundation of "base-line" knowledge any longer. Thus, an equal and simultaneous effort must be made to diversify and expand the base of our pyramid. This range of instruments, tightly-knit by measures to verify the accuracy of each component, is what scientists must seek to develop.

The concern at the top of this pyra-



mid is to arrive at standardized calibration points, accurate and reliable characterizations of environmental contaminants in each of the different media. These, then, will serve as reference points upon which to base all analytical methods.

### Limitations

Scientists constantly deal with physical limitations of environmental measurement methods. In fact, they are dedicated to exploring, defining, minimizing, and, when possible, eliminating them. So, scientists are well aware that all data is qualified by levels of confidence and probability, that no number is significant, and subsequently worthy of being recorded, without an estimate of its accuracy.

However, too many people, especially lawyers and legislators, believe the numbers generated by scientists without reservation. And, in too many instances, this naive faith in unquali-

fied numbers has led decisionmakers to promote regulations and policies whose justification was later seriously questioned, or whose implementation was eventually frustrated.

### Clean Air—1970

This was the case back in 1970, when the authors of the Clear Air Act Amendments mandated a 90 percent removal of oxides of nitrogen ( $\text{NO}_x$ ) from automobile emissions. This drastic regulation was based upon measurements which, unbeknownst to these politicians, were seriously in error and consequently distorted the health risks. Subsequent data has tended to reconfirm the wisdom of the original requirement for a 90 percent reduction in  $\text{NO}_x$ , but for different reasons.

As this single example, one of a regrettably large number of similar ones, illustrates, more effort should be channelled into documenting the need for accurate measurements.

Users of environmental data must be advised of its potential weaknesses. Unless they are, public officials may continue to formulate strategies whose undeniable repercussions upon the economy and public's health may not be warranted. Thus, I would like to emphasize the need for the inclusion of caveats whenever data is released, circulated, and interpreted.

But this one example points out another aspect of how scientific data is used. Frequently, the right decision is made for the wrong reasons. The guess for  $\text{NO}_x$  was either good, or lucky. In any case, those who use scientifically generated numbers to support their own policy frequently distort data to bolster their case. This is normal practice in politics.

### Chain of Events

Even the most seemingly trivial measurements strengthen the first link in the long chain of environmental  
*continued on page 22*

# NIKE Missile Site Revisited

(Photos by Mark Helfer)



NBS engineer John Jenkins inspects underground bunker where solar collector test rigs are stored on elevators.

**H**ARNESSING the energy of the sun to heat and cool homes has captured the imagination of many Americans. As a result, more than a hundred new companies manufacturing and offering solar energy systems have appeared. Despite this popularity, solar energy systems present a problem to builders and consumers who are interested in using them. Because there are no uniform methods for measuring the performance of such systems, there is no way to make meaningful comparisons among them.

To remedy this situation, the Energy Research and Development Administration (ERDA) asked the National Bureau of Standards to develop standard methods to test solar collectors and thermal storage units, the two principal components in all solar heating and cooling systems. Methods of testing collectors and thermal storage devices based on thermal performance were developed at NBS under the direction of engineer Dr. James Hill in the Thermal Engineering Section of the Building Environment Division, Center for Building Technology.

The proposed methods were submitted to the Standards Committee of the American Society of Heating, Refrigerating, and Air Conditioning En-

gineers. Standards based on the NBS test methods are now under open review by the ASHRAE membership and by the American National Standards Institute.

In the meantime, NBS began a second phase of the project for ERDA. This phase called for the construction of typical experimental apparatus to evaluate the test procedures. To carry out this end of the task, NBS staff researchers are using a former NIKE Missile Site located next to the Bureau's grounds in Gaithersburg, Maryland. The site offers an ideal test location since the collectors and storage units can be stored in underground bunkers where the NIKE missiles used to be and tested in the sunlight, as shown in the accompanying photographs.

Under test by NBS engineers are three different air-heating solar collectors, a pebble bed thermal storage unit, and 10 different water-heating solar collectors. After the test procedures have been fully evaluated, necessary modifications will be made to the proposed standards and will be incorporated in the ASHRAE voluntary performance standards for the industry. Ultimately, it is expected that the results will be extended to standards for evaluating total solar heating and cooling systems. MJ □





*Elevator carrying an air-heating solar collector array rises from underground bunker. Engineers Jenkins and Dennis Jones wipe glass cover plates prior to test.*



*Jenkins and technician Donn Ebberts turn the air-heating collector test loop around to face directly south.*



*Jenkins shades the pyranometer (which senses the incident solar radiation) during a test of a high performance evacuated tube water heating solar collector. This procedure must be carried out during the test.*

*Jenkins inspects strip chart recorder, used to collect data during a typical solar collector test.*



# HIGHLIGHTS

## **First Energy-Efficient Federal Building Dedicated**

A General Services Administration building dedicated last month in Manchester, New Hampshire, is the first federal facility to be built with energy conservation as the primary concern. The new office building was designed through use of an NBS computer program to predict heating and cooling loads under a variety of conditions. The program, called National Bureau of Standards Load Determination, allowed the designer and architect to choose the most effective designs, materials, and equipment. Under Energy Research Development Administration sponsorship, NBS designed an extensive monitoring and instrumentation system that will be used to evaluate the seven story building's actual energy consumption for 3 years. The data that are acquired and analyzed during this project should lead to criteria for more energy-conserving buildings. NBS engineers also assisted GSA in the design and selection of the solar heating and cooling systems, which serve approximately 30 percent of building energy requirement and will be a part of HUD/ERDA solar energy demonstration program.

## **Laser Technique for Measuring Pollutants Developed**

Scientists at NBS have developed a rapid procedure for measuring, at the part-per-million level, two of the pollutants found in automobile exhaust: NO and NO<sub>2</sub>.

In this technique, the molecular absorption frequency of NO or NO<sub>2</sub> is shifted by an applied magnetic field into coincidence with infrared lines

of a CO laser. By changing the magnetic field, researchers achieve a molecular line profile that allows highly selective analysis and produces improved signal-to-noise ratio.

## **Workshop on Applications of Phase Diagrams Scheduled**

NBS will sponsor a three-day workshop aimed at stimulating production of more relevant and useful compilations of phase diagram data for alloys, ceramics, and semiconductors at its facilities in Gaithersburg, Md. on January 10-12, 1977. Topics to be discussed at the workshop will include identifying resources that are now being expended that could be made more useful by coordination and to suggest areas of international cooperation. Persons interested in contributing papers should contact conference chairman Dr. Lawrence Bennett, Materials Building, B150, National Bureau of Standards, Washington, D.C. 20234.

The workshop is sponsored by the NBS Institute for Materials Research and the Office of Standard Reference Data. Persons interested in receiving additional information about the workshop should write to Ronald B. Johnson, Materials B348, National Bureau of Standards, Washington, D.C. 20234.

## **Standard Reference Data Journal Issued**

The third issue of Volume 5 of the Journal of Physical and Chemical Reference Data has been published. A joint enterprise of the American Institute of Physics, the American Chemical Society, and the National Bureau of Standards, the Journal is

the major periodical publication of the National Standard Reference Data System.

The current volume contains: tables of critically evaluated oscillator strengths for atomic spectra of Li I through Ni XXVI; ideal gas thermodynamic properties of six chlorofluoromethanes; and a survey of superconductive materials and critical evaluation of selected properties.

Journal subscriptions are available from the American Chemical Society, 1155-16th Street, N.W. Washington, D.C. 20036.

## **System for Monitoring Noise Being Developed**

NBS and the Office of Railway Safety Research and Development of the Federal Railroad Administration have initiated a program to develop a self-contained remote noise monitoring and analysis system for use in locomotive cabs. This system will be used in future studies of the noise levels in railroad locomotives as a part of an ongoing series of studies of the operating crew's exposure to environmental effects.

## **Standards for Burglar Alarm Sensors Prepared**

The NBS Law Enforcement Standards Laboratory and the Army have developed performance standards for two types of burglar alarm system sensors: ultrasonic motion detectors and microwave motion detectors. The standards will be published by the sponsoring agency, the Justice Department's National Institute of Law Enforcement and Criminal Justice. □

## Conference Planned on Corrosion of Metals in Buildings

**A** conference designed to promote dialogue between corrosion engineers and members of the building industry concerned with corrosion of metals will be held at the National Bureau of Standards in Gaithersburg, Md., from May 16 to 18, 1977.

The conference is to be sponsored by NBS, the National Association of Corrosion Engineers and the Construction Specifications Institute.

The first day will be devoted to presentations on the fundamentals of corrosion and corrosion control. The remaining day and a half will deal

with specific corrosion problems, including socio-economic concerns, encountered by the building industry.

A preliminary announcement of the conference will be mailed in November. Those wishing to receive this announcement should contact: Dr. Jerome Kruger, chief, Corrosion and Electrodeposition Section, Room B252 Materials Building, or Dr. Geoffrey Frohnsdorff, chief, Materials and Composites Section, Center for Building Technology, IAT, Room B348 Building Research, National Bureau of Standards, Wash., D.C. 20234.



## Current Developments in Stereology Published

**M**ORE than 100 papers on the principles of stereology and its applications to other fields of science are now available in one volume from the National Bureau of Standards.

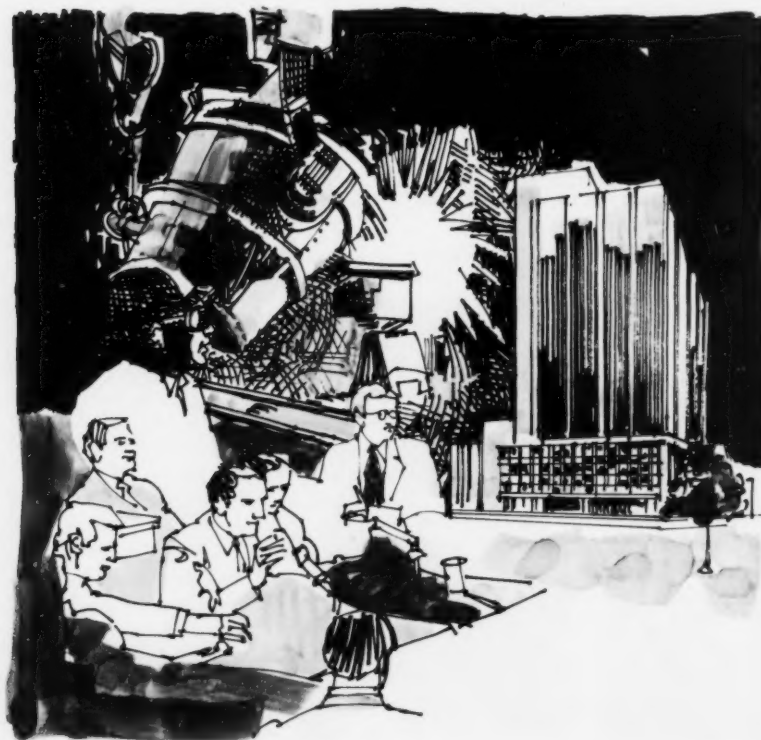
The papers were presented at the Fourth International Congress for Stereology last year at NBS facilities in Gaithersburg, Md., September 4 to 9. The congress, which brought together some 150 scientists from 16 countries around the world, was cosponsored by NBS, the International Society for Stereology, and the National Science Foundation.

Stereology is a branch of measurement science in which three dimensional structures are deduced from the examination of two dimensional images. The field has applications to structural and measurement problems in mineralogy, materials engineering, biology, anatomy, clinical medicine, architecture, geography, and space science.

The congress proceedings provide accounts of state-of-the-art developments in stereology, principles and mathematical developments, pattern recognition, instrumentation, three dimensional reconstruction, and applications in materials, biology, and medicine.

In addition, the 547-page hard cover book includes articles on special techniques and methods used in stereology.

"Proceedings of the Fourth International Congress for Stereology," is available for \$11 a copy (\$13.75 for foreign mailing) from the U.S. Government Printing Office, Washington, D.C. 20402. Order by SD Catalog No. C13.10:431.



## Catalog of 1975 Papers Available

**T**HE National Bureau of Standards has issued a 592-page catalog of the Bureau's 1975 publications, including information on prior NBS compilations and the availability of NBS papers published in past years and tables of contents for the twelve 1975 issues of the Bureau's monthly news-magazine, *DIMENSIONS/NBS*.

About half of the nearly 2000 papers listed were issued in the Bureau's own publication series and the other half in non-NBS journals, books, and proceedings.

The catalog supplements prior annual NBS listings which, in the 75 years of the Bureau's existence, total 32,363 papers published in the open literature. Some of these are considered to be classic contributions and many still stand as scientific and scholarly references.

The papers cited include full title, author(s), place of publication, abstract, and key words. Author, key word, and subject area indexes help make the catalog useful for browsing or as a reference source.

NBS papers published in the Bureau's own publication series are sold by the Superintendent of Documents and also, in microfilm, by the National Technical Information Service. Papers published in non-NBS media are available through normal open-literature channels, including the publishers and, by request, from the NBS authors.

An added feature is the inclusion among the publications series of citations for papers which have appeared in the *Journal of Physical and Chemical Reference Data*, published for NBS by the American Institute of Physics and the American Chemical Society.

The catalog was edited by Betty L. Hurdle, NBS Office of Technical Publications, and produced by computer-assisted photocomposition techniques.

Copies are for sale by Superintendent

of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Order by SD Catalog No. C13. 10:305 Suppl. 7. Price \$7.55. (Add 25 percent additional for other than U.S. mailing.) ☐

## NBS Scientists Win Four Awards in I-R 100 Competition

**S**CIENTISTS from the National Bureau of Standards have won four awards for the most significant new technical products in 1976 in the I-R 100 competition sponsored by Industrial Research magazine.

The NBS winners and their products are:

- James S. Albus of the Institute for Computer Sciences and Technology for development of a cerebellar model arithmetic computer.
- David E. Sawyer and David W. Berning of the Institute for Applied Technology for development of a laser flying-spot scanner.
- Helmut Hellwig of the Institute for Basic Standards for development of a rubidium portable clock (in cooperation with EFRATOM, Inc., Costa Mesa, Calif.).
- David W. Allan of the Institute for Basic Standards for development of a dual mixer time difference measurement system.

### Computer

Albus' memory device was inspired by the human brain's subconscious computing centers that control such daily activities as picking up a drinking glass or combing hair. The device is currently used as a servo controller for a robot manipulator. It will soon be applied to machine tool control problems and to neurological and behavioral research.

The cerebellar model arithmetic computer (CMAC) differs radically from conventional computers in physical structure, method of computation, and program representation. With a "practical size" memory, CMAC exhibits most of the elements of learning, generalizing, associative recall and context-sensitive decision making which are observed in animal and human conditioned reflexes.

CMAC modules can help control manipulators, machine tools, fly-by-wire auto pilots, walking machines,

remotely piloted vehicles, continuous-flow industrial processes, or automatic factories. CMAC can also be used as a model of insect, animal or human behavior in order to study motor coordination and development, learning disabilities, and speech understanding and generation.

### Laser Scanner

Sawyer and Berning's device, the laser flying-spot scanner, displays in a non-destructive manner the inner workings of integrated circuits and other semiconductor devices. The scanner can be used to assist in the design of semiconductor devices and circuits and in the detection and location of marginal device elements. It can help in establishing product

reliability and in providing a tool for failure analysis.

The scanner can map dc and high-frequency gains in transistors, reveal areas of the device operating in a non-linear manner, electronically map temperature in the transistor, and detect the location of hot spots that can develop for certain operating conditions.

Mapping is performed by scanning the semiconductor device with light from a low-power CW laser which locally creates electron-hole pairs within the structure. These current carriers can be detected since they enhance the signal current-carriers which are supplied by leads fixed to the device.

### Atomic Clock

Hellwig, chief of the Frequency and Time Standards Section at NBS-Boulder, Colo., developed a portable rubidium atomic clock that offers long battery operation (20 hours), light weight (11 to 20 kilograms depending on kind of battery) and small volume (17 000 cubic centimeters), and that is precise to 0.1 microsecond.

The new clock system allows world-wide time comparisons with much more convenience than existing cesium atomic clocks because of its increased portability. It permits easier handling without sacrificing accuracy and precision of timekeeping ability required for world-wide clock com-

turn page

*Dr. Helmut Hellwig, a physicist at the NBS Boulder (Colo.) Laboratories operates a portable rubidium atomic clock which he developed. The clock is much smaller, lighter, and capable of operating on battery power much longer than previous atomic clocks. It permits more frequent, inexpensive trips to compare independent clock systems, such as are maintained as time standards in many countries.*

*(Photos by Harry Covey)*

*David W. Allan, a physicist at the NBS Boulder (Colo.) Laboratories, adjusts the dual mixer time difference measurement system that he developed. The device was named one of the 100 most significant new products of 1976 by Industrial Research Magazine. It is used to measure the performance of extremely accurate time and frequency standards, such as atomic clocks, and to measure the time and frequency characteristics of various electronic and opto-electronic components.*





## SCIENTISTS *continued*

parison trips. The new system can be carried in cars, boats and small aircraft to locations up to now inaccessible because only large aircraft had the necessary power outlets.

The new rubidium portable clock will be manufactured and sold by EFRATOM, Inc., of Costa Mesa, Calif., and will be available soon.

### Dual Mixer System

The dual mixer time difference measurement system developed by David W. Allan, associate chief of the Frequency and Time Standards Section at NBS-Boulder, provides an improved means of determining variations in the time difference between

two state-of-the-art clocks or frequency standards. The new system has a measurement precision better than any commercial clock including atomic clocks. It provides a digital readout of the time difference with a precision of 0.1 picosecond, 500 to 1000 times better than previously available devices, at about the same cost.

This device is uniquely suited for time and frequency measurements of time delay variations of coaxial cables, optical transmission fibers, radio-frequency connectors, and isolation amplifiers. When combined with other components, the dual mixer time-difference measurement system

can provide full characterization of the quality of a state-of-the-art time and frequency standard. Where the accuracy of previous methods was limited by problems of the measurement system, this new system will allow accuracies limited only by the clocks themselves.

Two slightly different versions of this system are being marketed by Timing Systems, Inc., Marblehead, Mass., and Boulder Scientific Research and Development, Inc., Boulder, Colo. Organizations such as the U.S. Naval Research Laboratory, Johns-Hopkins Applied Physics Laboratory, Rockwell International, and Hughes Aircraft have ordered these units. □

David W. Berning (left), an electronics engineer, and David E. Sawyer, a physicist, operates the laser flying-spot scanner they developed for testing semiconductor devices. Berning and Sawyer work in the Electronic Technology Division.

James S. Albus, an electrical engineer in the Institute for Computer Sciences and Technology, operates a robot manipulator that is being controlled by the cerebellar model arithmetic computer (CMAC) that he developed.

(Photos by Mark Helfer)





## Calibration Service for Diagnostic X-Ray Units Provided

**A** calibration service for high voltage dividers used with diagnostic X-ray units has been established by the National Bureau of Standards as part of a nation-wide effort to reduce unnecessary exposure to X-rays.

The service can have a great impact on radiographic dosage since it is estimated that every year about 50 percent of the American public has a diagnostic X-ray of one kind or another.

A divider (sometimes referred to as a "bleeder bank") is a device consisting of a number of resistors. When hooked into the high voltage point of an X-ray unit, it "divides" the voltage, reducing the voltage low enough to be measured. By insuring the consistency of the peak voltage from X-ray unit to X-ray unit and from day to day within the same unit, a calibrated divider enables patient dosage to be reduced.

Consistency cuts the number of non-uniform film exposures, thereby reducing the number of retakes required, and makes possible a finer selection of voltage level to enhance tissue contrast effects.

The service, now offered on a reimbursable basis, has completed a trial year in which more than 25 dividers made by major manufacturers were calibrated for the Bureau of Radiological Health (BRH), U.S. Department of Health, Education and Welfare. By insuring that manufacturers measuring systems are consistent with those at NBS, consistency is disseminated through the manufacture and sale of apparatus. Calibration of dividers for medical centers provides an additional opportunity for quality control among large-scale users of X-ray radiography.

NBS developed the service as a re-

## Report to Aid in Developing Computer Standard

**A** report expected to provide a basis for a computer disk device level interface standard has just been issued by the Institute for Computer Sciences and Technology (ICST) of the National Bureau of Standards.

Prepared by Auerbach Associates under NBS contract, the report deals with characteristics of the interfaces between high-performance disk drives and their controllers. It describes functional and electrical characteristics for drives with a storage capacity of 100 megabytes or higher and using removable media.

NBS has reviewed the report and concluded that there is sufficient commonality in the interface characteristics of the surveyed equipment to justify the development of a standard.

The Federal Information Processing Standards Task Group on Automatic Data Processing (ADP) Interface Standards will use the report in developing a standard applicable to

both large-scale and minicomputer systems. The aim is to facilitate more economical procurement and more efficient utilization of Federal ADP equipment by allowing the interchangeability of disk drives procured on a fully competitive basis.

NBS has also submitted the report to the American National Standards Institute (ANSI) X3T9 I/O Interface Subcommittee with the recommendation that an ANSI device level interface standard be developed.

Copies of the report, *Disk Drive Interface Characteristics* (publication PB 256440) may be purchased for \$5.50 from the National Technical Information Service (NTIS), Springfield, Va. 22151. Microfiche copy is available for \$2.25.

For additional information about the report, contact Jogindra M. Bakshi, B212, Technology Bldg., National Bureau of Standards, Washington, D.C. 20234. Telephone: 301/921-3723. □

sult of studies of electrical measurement problems. These efforts, supported in part by BRH, included analyses of commercially available dividers and measurement of voltage waveforms in three X-ray units. Feedback from BRH and from practitioners helped define both apparatus and procedures for the calibration system.

Study results and some of the implications of the calibration service are contained in a report, "Electrical

Measurement of High Voltage Pulses in Diagnostic X-ray Units," NBSIR 75-775, 1975. Copies may be obtained free of charge by writing the author, Dr. Robert E. Hebner, Jr., B344 Metrology Bldg., National Bureau of Standards, Washington, D.C. 20234. Copies may also be obtained from the National Technical Information Service, Springfield, Va. 22151, Report #PB 248 684. Price: hard cover, \$4.50; Microfiche, \$2.25. □

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## NBS Publishes Voluntary Toy Safety Standard

**D**R. Ernest Ambler, acting director of NBS, has approved for publication a Voluntary Product Standard that establishes nationally recognized safety requirements for toys intended for use by children up to 14 years of age.

Under Department of Commerce procedures for the development of a Voluntary Product Standard, the signature of the director of NBS is required before the standard can become effective.

Ambler said that the standard, requested by the Toy Manufacturers of America (TMA), the industry's trade association, allows producers and distributors to identify toys that conform to the standard through appropriate marking, labeling, and advertising.

"This lets the consumer know which toys comply with the standard and gives the consumer assurance that the toy should be safe during normal use or reasonably foreseeable abuse," the NBS acting director stated.

Reasonably foreseeable abuse would include instances of children taking toys apart, dropping or throwing them, or using them for purposes other than intended.

The standard contains requirements for material quality, flammability, toxicity, packaging film, strings and elastics, electrical or thermal energy, impulsive noise, edges, hazardous points, and projections.

It also contains requirements for wheels, tires, and axles; folding mechanisms, and hinges; holes, clearances and protection of mechanisms; stability of ride-on toys and seats; overload requirements for ride-on objects; simulated protective devices such as helmets, hats, and goggles;

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## Use of Color in Health Care Institutions to be Topic of Special Workshop

**T**he National Bureau of Standards' Center for Building Technology will sponsor a special workshop on "Color in the Health Care Environment," on November 16 at NBS headquarters in Gaithersburg, Md.

Although color is used daily in countless ways to make surroundings more attractive, the benefits of color use in the health care environment have not been understood clearly. Reliance has been placed on individual feelings about the affects of color rather than on quantitative measures of color benefits and liabilities.

The workshop, which is open to members of the medical community, will seek to develop awareness of what is known (and not known) about colors, their use and overall effectiveness. Use of color in specific areas, such as operating rooms, will be discussed.

Presenters will include William C. Beck, M.D., president of the Donald Guthrie Foundation for Medical Research; Marcella Graham, an institutional design consultant; John E. Flynn, AIA, professor of architecture, Penn State University, and Thomas Sisson, M.D., Temple University School of Medicine.

A roundtable discussion will include the speakers plus Kenneth Kelly, a color expert with NBS; Alexander F. Styne, an industrial design consultant, and Corwin Strong of the National Institutes of Health Clinical Center.

Further information may be obtained by calling Kenneth Kelly (301/921-2177) or Brian Pierman, Safety Research Coordinator in CBT's Office of Housing and Building Technology (301/921-3126). □

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projectiles; and labeling, literature, and marking.

The standard contains inspection and test procedures to be used to determine the conformance of toys to the requirements.

Articles not covered by the standard include bicycles; kites; sling shots and sharp-pointed darts; crayons, paints, chalks, and other similar art materials; playground equipment; B-B guns; hobby and craft items and model kits in which the finished item is not primarily of play value; sporting goods, camping and athletic equipment, musical instruments, and

furniture, and powered models of aircraft, rockets, boats, and land vehicles.

Printed copies of the standard, designated PS 72-76, will be available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, in 3 to 4 months. In the meantime, recommended standard TS 215b having the same title, dated August 29, 1975, may be used. Single copies of TS 215b are available free of charge from the Standards Development Services Section, National Bureau of Standards, Washington, D.C. 20234. □

According to Ryan, NBS designed and installed the data collection system for monitoring the performance of the plant and has recently placed the system into operation.

### NBS Monitoring

The extensive electronic data acquisition system is collecting data on over 300 system parameters that provide information on site electrical and thermal loads (heating, cooling, and hot water), service reliability, component efficiency, and fuel consumption. In the NBS monitoring system temperature difference sensors monitor the site distribution hot and chilled water systems as well as the plant heat conveyance systems, component lubricating oil, and exhaust gases. Fluid flowmeters measure the flows of water and fuel oil. Other sensors measure the voltage and electrical energy of the plant and site electrical systems. Plant operating events and weather conditions are also monitored. This information is collected electronically on tape at the test facility and analyzed at the NBS laboratories in Gaithersburg, Md. Component reliability data, operation and maintenance costs, and environmental data are separately collected for analysis.

Ryan explains that "the data collected and the evaluations conducted will assist electric utilities, mechanical engineers, architects, community planners, municipal governments, energy policy makers, developers, and financial institutions to evaluate the potential of alternative community energy systems. By the end of the first year of evaluation, a data base will be available on the capabilities,

limitations, and efficiency of a total energy system servicing a residential community."

Preliminary data collected by the NBS effort have primarily served to check out the data acquisition system. The data now being collected, when complete, may substantiate original NBS estimates that the total energy system can significantly reduce the amount of fuel needed to supply the development's energy requirements. Prior to the HUD decision to construct the total energy plant, NBS conducted a study which showed that an energy savings of up to 36 percent could be achieved at the Jersey City site.

The site at Jersey City is a complex of 485 apartment units, a school, and a small commercial building. It is typical of residential redevelopment projects in the urban core. The apartment units, in four separate buildings, are fully occupied. The total energy plant provides electricity, space heating and cooling, potable water heating, and solid waste collection for all units within the complex. The facility operates on No. 2 diesel oil. Underground storage tanks provide fuel to five diesel engine-generators with a total capacity of 3000 kilowatts and two auxiliary boilers at 3930 kilowatts each. The plant, operating independently of local electric power networks, has been designed so that any three of the engines can carry the estimated peak electrical demand, allowing for one unit in reserve when one is undergoing scheduled maintenance.

### Opportunities and Future Plans

The multi-year total energy evalua-

tion efforts being conducted by NBS is one of the largest field data acquisition efforts in the history of the Bureau. The effort began in 1970 and is expected to continue into early 1978 when the basic evaluation will be completed. The Jersey City site represents a field laboratory where analyses of real-world operating energy systems can be conducted. In addition to evaluation of total energy systems, data collected from the site will allow updating of methods used to analyze and predict residential energy loads such as electrical power consumption, domestic hot water usage, and space heating and cooling requirements.

The opportunity to fully utilize the field laboratory capability of the Jersey City plant has been well recognized by HUD. An innovative pneumatic trash collection system has been installed at the site and is being evaluated by HUD. Future plans include installation of solid waste incineration with heat recovery to recycle trash generated within the development into useful energy. Other plans call for installation of energy storage devices, innovative electric power generation systems, and solar energy systems. NBS will be concerned with the evaluation of these new elements as they are installed.

Both total energy systems and the MIUS concept appear to offer a substantial promise of eventually easing the plight of public utilities; which must cope with the demands of an ever-growing number of communities across the country. The goal of the HUD program is to see whether this promise can become a reality.

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